

Question 1 Scoring Guide

Each bullet is worth one point:

Part a. (maximum 6 points)

- **Optimum** temperature and pH *concept* [must include both temp and pH]
- **Enzyme/Substrate Fit** *concept*
(function dependent on conformation complementarity between enzyme and substrate)
- **Tertiary** (and sometimes quarternary) structure **determines** function
- Description of enzyme **structure or function**, e.g.

Structure	Function
Elegant description of primary to tertiary or primary to quarternary levels of structure	Increases rate of reaction
Protein folding/coiling	Increases proximity of reactants
Co-enzymes/co-factors	Decreases activation energy of the catalyzed reaction
Zymogens	Decreases time to reach equilibrium
Allosteric effectors	Induced fit and/or orbital steering (“bond stress”)

- **Denaturation** *concept* [temp and/or pH] linked to decreased enzyme activity
(e.g. “denaturation” in context or unfolding or change in 3D shape, **not** “enzyme breaks down”)
- **How temperature affects** conformation
(increased temperature breaks specific bonds, e.g. hydrogen, Van der Waals, disulfide bridges)
- **How pH affects** conformation
(change in H⁺ concentration causes a change in specific bond interactions, e.g. hydrogen; ionic; R-group interactions)
- **Kinetics** (increased or decreased molecular movement) linked to effect on enzyme activity due to increase or decrease in temperature up to the optimum

Part b. maximum 6 points

Experimental design must be relevant to the data shown in the graphs

- **What is measured** (e.g. product formed or substrate used)
- **How is it measured** (titration or spectrophotometry or color change or bubbles counted, etc.)
- The **independent variable** (temperature/pH) is **manipulated** to produce the results [at least 3 data points are identified]
- The described experiment **could produce these data**
(Experimental design included sufficient range, varied the temp/pH of the reaction mix not the enzyme, what was measured, and how it was measured)
- Held **experimental factors constant** (specified at least one)
- Specified a **control group for comparison** (no enzyme or boiled enzyme or no substrate)
- **Verified** results (e.g. repeated trials; results represent an average)
- **Hypothesis** clearly related to experiment of choice, and clearly identified as a hypothesis; can use the if/then...form.